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QUASI-COHERENT DETECTION FOR SuperPON

…Enabling low power transmitters and
long reach 10 Gbps and 25 Gbps with dispersion compensation…

BIFROST COMMUNICATIONS APS

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Spin-out from
Technical University of Denmark

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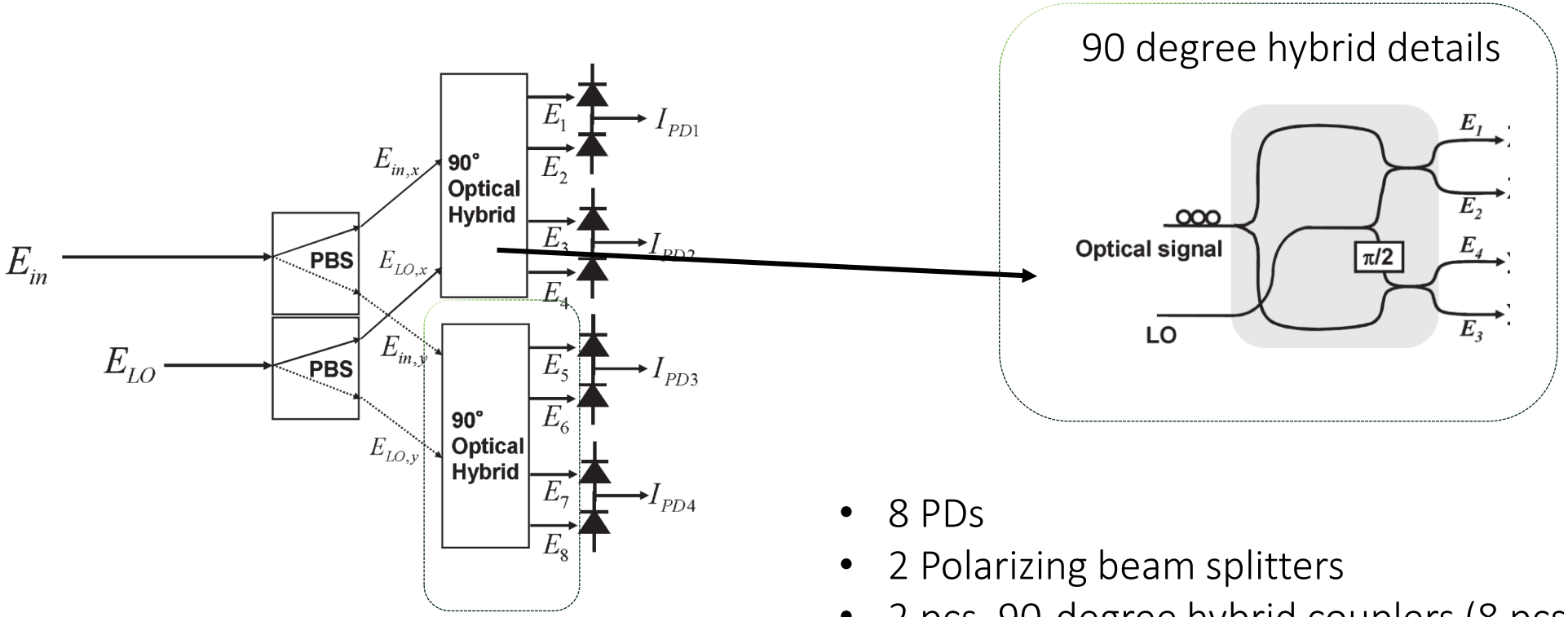
Outline

1. What is Quasi-Coherent Detection?
2. SuperPON Requirements
3. Going to 25 Gbps with CD compensation built into the receiver
4. Lower EDFA gain and ONU launch power requirements reduce SuperPON cost where it matters
5. Outlook

Digital Coherent Receiver – The Conventional Way



- 8 PDs
- 2 Polarizing beam splitters
- 2 pcs. 90-degree hybrid couplers (8 pcs. 3dB couplers)

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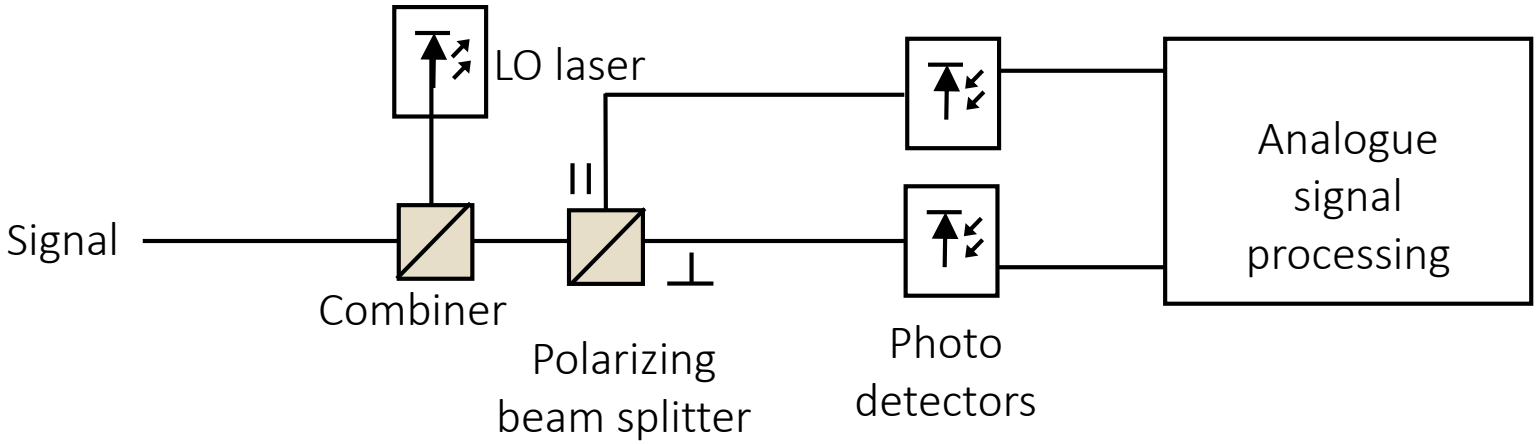
Bifrost Simplified Quasi-Coherent Receiver



- Only very little equipment (2 PDs, 1 PBS, 1 pcs. 3 dB coupler)
- No DSP (Analog signal processing chip only consumes 10 mW)
- Vast simplification
- Coherent potentially ready for low cost access networks

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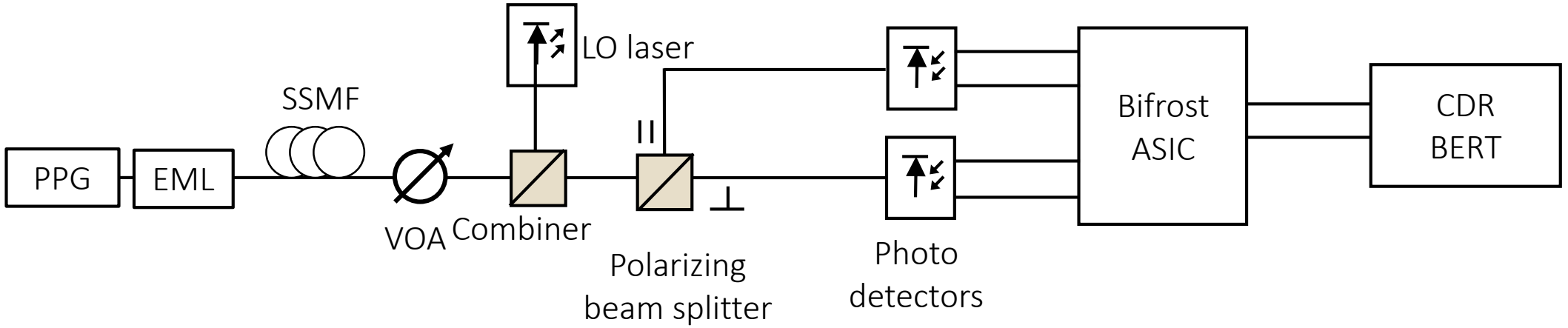
Experimental Validation @ 10 Gbps



- SFP transmitter, 1550 nm wavelength, 8 dB extinction ratio
- 15 dBm LO power, RIN = -145 dBm/Hz
- 33 GHz PD bandwidth (for burst mode, 14-18 GHz needed for continuous mode)

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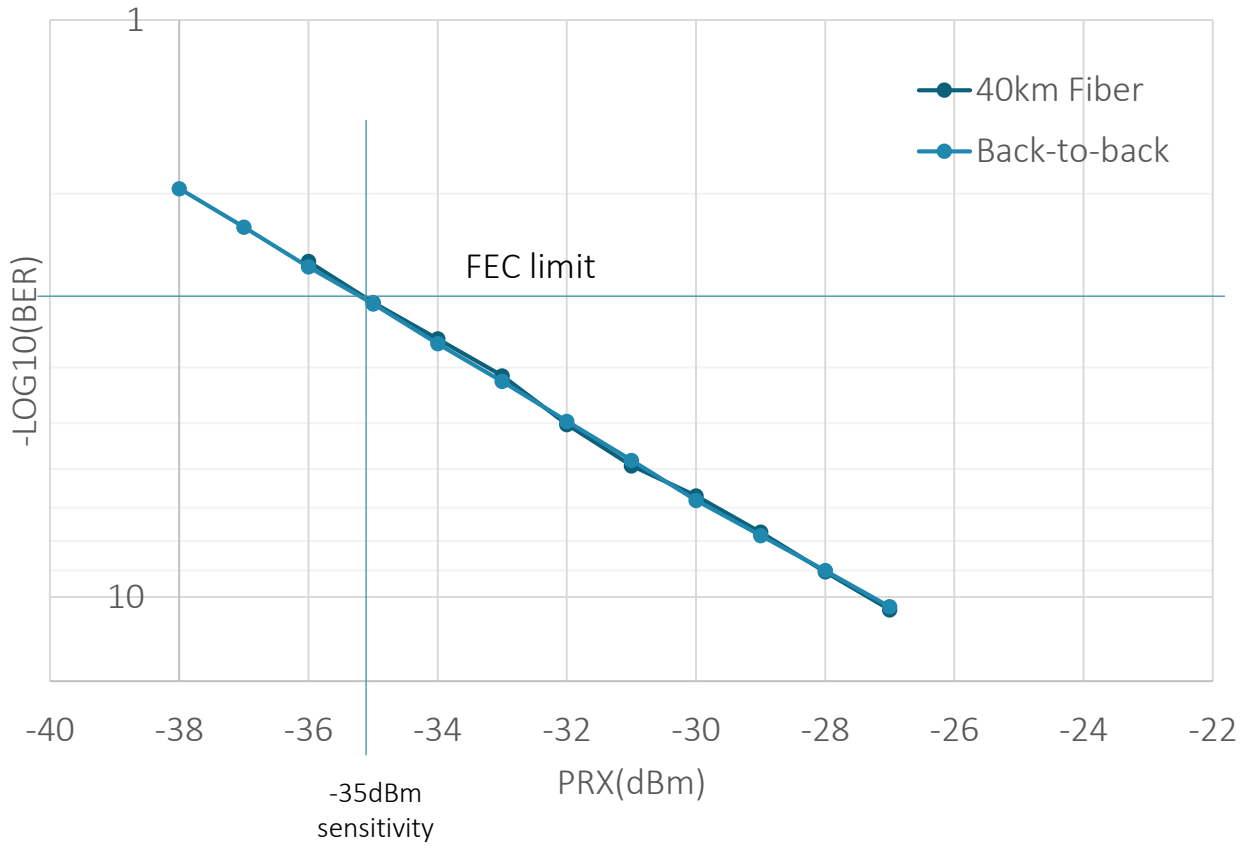
10 Gbps BER B2B and after 40 km SSMF

1550nm EML transmitter

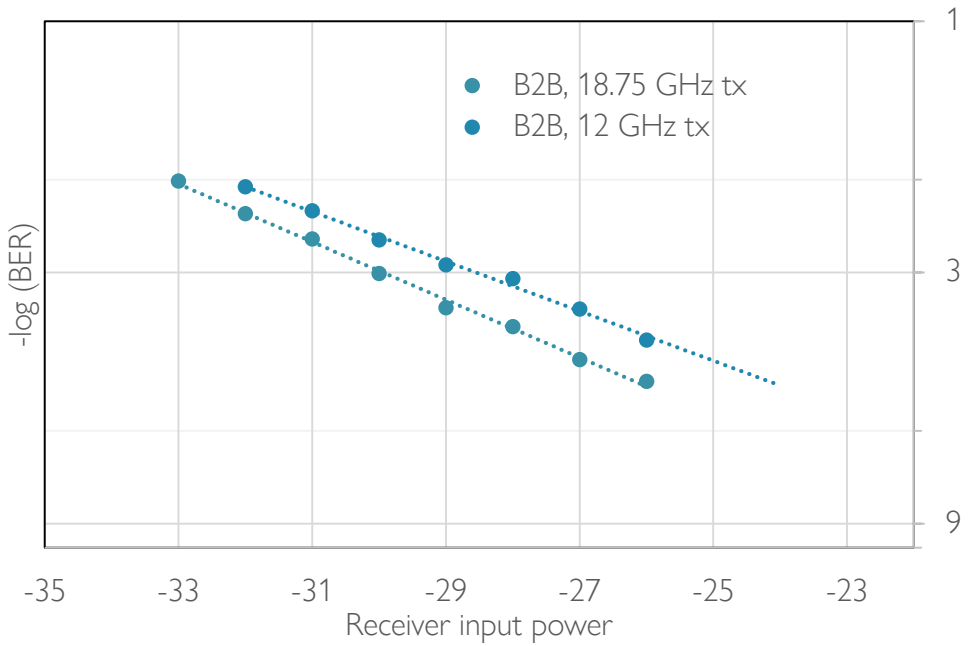
-35 dBm sensitivity
No degradation after 40 km fiber

15 dB better than PIN DD
3-6 dB better than APD DD

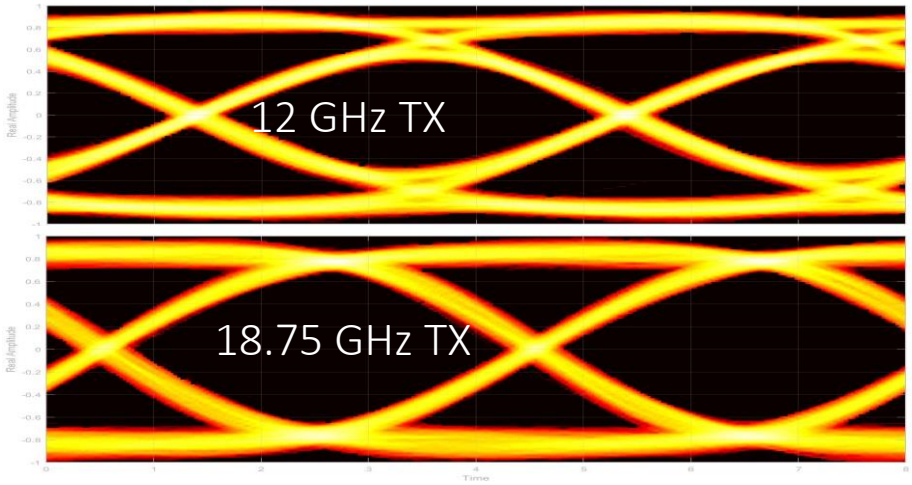


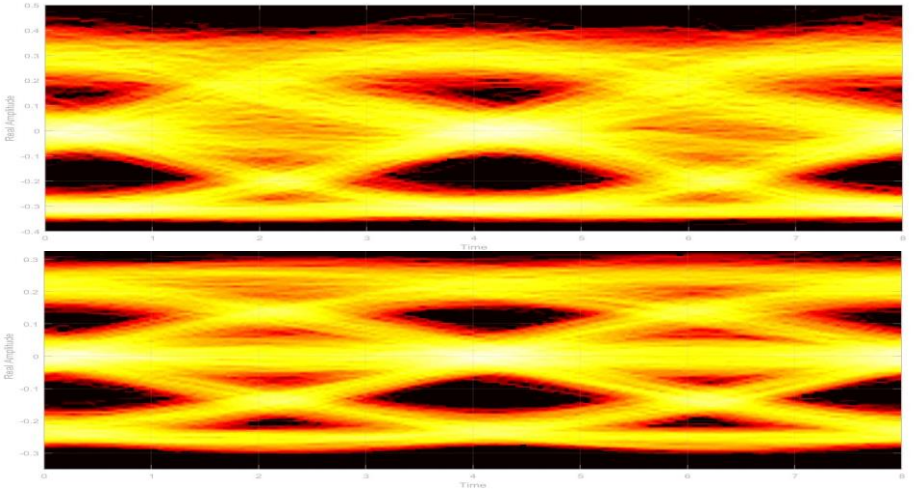
First experimental results – 1550 nm

25 Gbps - B2B - Matlab demodulation to NRZ



- -30 dBm B2B sensitivity with full transmitter bandwidth
- 2 dB penalty from reducing transceiver bandwidth to 12 GHz
- Eye diagram after 20 km SSMF completely distorted

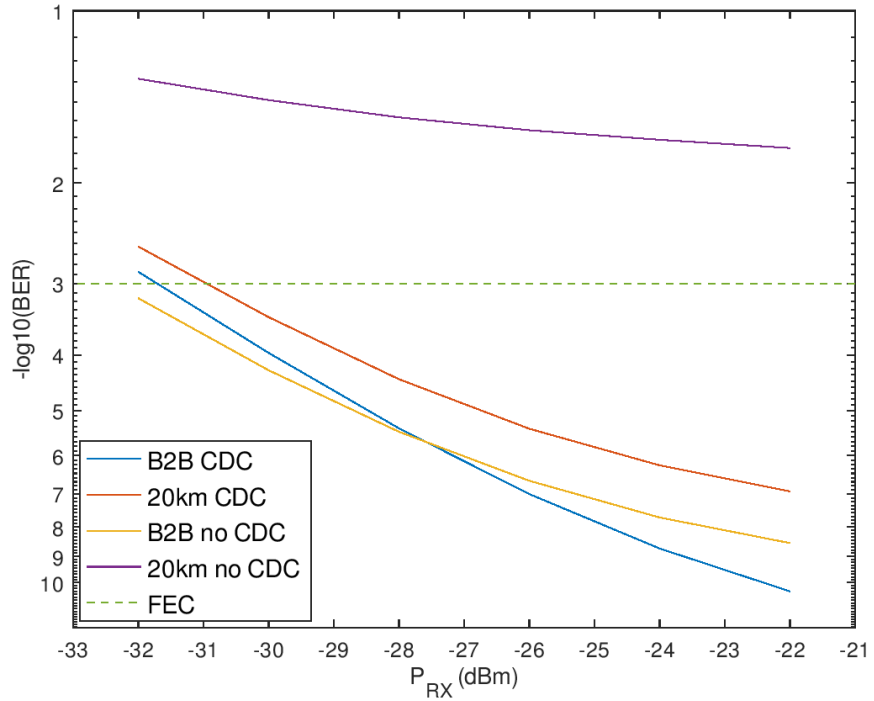




Receiver filter optimized for NRZ

Receiver filter optimized for EDB

25 Gbps Chromatic Dispersion Compensation



Optics modelled in VPI using datasheet values

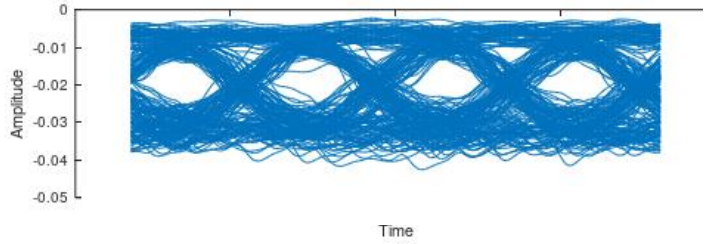
- 10 MHz LO linewidth, -145 dB/Hz LO RIN, 15 dBm LO power
- PD 3-dB bandwidth = 40 GHz
- PD responsivity 0.7 A/W
- TX Extinction ratio 8dB (1550 nm EML)

Bifrost ASIC EM simulated in Microwave Office

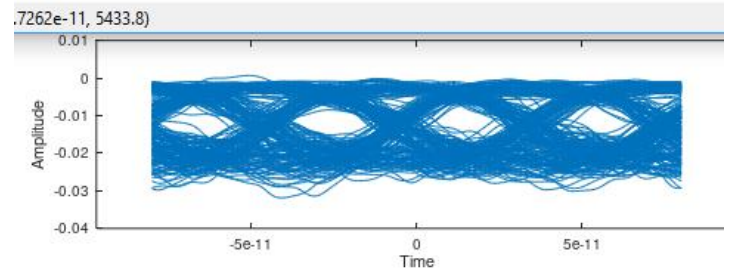
Better than -30 dBm sensitivity B2B and after 20 km SSMF

-30 dBm eye diagrams

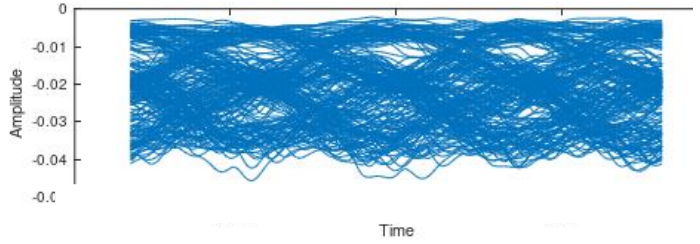
B2B No CDC



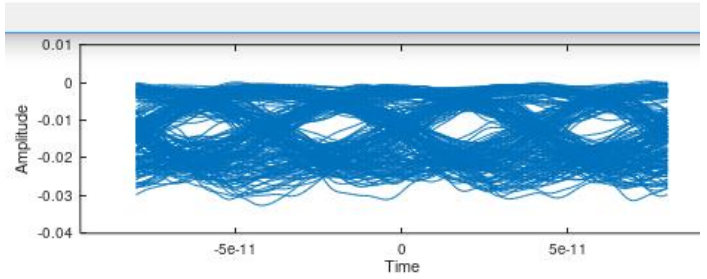
B2B with CDC



20 km No CDC



20 km with CDC



Quasi-Coherent SuperPON

Super-PON Objectives

To support a passive point-to-multipoint ODN with a reach of at least 50 km, and with at least 1:64 split ratio per wavelength pair

- At least 16 wavelength pairs for point-to-multipoint PON operation
- Support the MAC data rate of 10Gb/s downstream
- Support the MAC data rates of 2.5Gb/s and 10Gb/s upstream
- Tunable transmitters

Conventional Optics requirements (RX sens -28.5 dBm)

- ONU launch power 4-9 dBm
- EDFA Gain (US) 14.5 dB

Optical CD comp in MUX needed for 25 G and 10 G DML

Bifrost QC-optics Requirements (RX sens -35 dBm)

- ONU launch power 0-5 dBm
- EDFA gain (DS) 12 dB

CD comp can be built into receiver cost-free and loss-less

SUMMARY

Quasi-coherent	25 Gbps	Status	SuperPON
Up to -35 dBm sensitivity @ 10 Gbps Up to -30 dBm sensitivity @25 Gbps (B2B)	20 km C-band transmission CD-compensation in receiver	10 Gbps ASIC ready 25 Gbps ASIC w/CDC Taped-out	Reduced ONU launch power or EDFA gain 2.5G, 10G, or 25G with no DCF